



भारत सरकार GOVERNMENT OF INDIA  
अंतरिक्ष विभाग DEPARTMENT OF SPACE  
भारतीय अंतरिक्ष अनुसंधान संगठन INDIAN SPACE RESEARCH ORGANISATION  
राष्ट्रीय सुदूर संवेदन केंद्र NATIONAL REMOTE SENSING CENTRE  
बालानगर, हैदराबाद BALANAGAR, HYDERABAD 500 037

No: NRSC-RMT-1-2024/10

### Syllabus for Written Test

Advertisement No	:	NRSC-RMT-1-2024 dated 22.01.2024
Name of the post	:	Scientist/ Engineer 'SC'
Post Code	:	10
Specialization	:	Geology
Essential Qualification	:	M.Sc in Geology / Applied Geology or equivalent With B.Sc in Geology / Applied Geology
Number of Posts	:	04

The syllabus for the above posts is given below. Candidates may note that it is not exhaustive but indicative only. Refer above advertisement for pattern of the examination.

#### Part-A: Area/ Discipline Specific part (90 Minutes, 80 Marks, 80 Multiple Choice Questions)

##### **Planetary Systems:**

Terrestrial planets and moons of the solar system; size, shape, internal structure and composition of the earth, milky way and the solar system. Modern theories on the origin of the Earth and other planetary bodies. Earth's orbital parameters, Kepler's laws of planetary motion, Geological Time Scale; Space and time scales of processes in the solid Earth, atmosphere and oceans. Radioactive isotopes and their applications. Meteorites Chemical composition and the Primary differentiation of the earth.; concept of isostasy; elements of seismology – body and surface waves, propagation of body waves in the earth's interior, Physico-chemical and seismic properties of Earth's interior.; Heat flow within the earth; Gravitational field of the Earth; geomagnetism and palaeo-magnetism; continental drift; plate tectonics – relationship with earthquakes, volcanism and mountain building; continental and oceanic crust – composition, structure and thickness. Basic concepts of seismology and internal structure of the Earth. Evolution of lithosphere, hydrosphere, atmosphere, biosphere and cryosphere, lithological, geochemical and stratigraphic characteristics of granite – greenstone and granulite belts. Stratigraphy and geochronology of the cratonic nuclei, mobile belts and Proterozoic sedimentary basins of India. Life in Precambrian. Precambrian – Cambrian boundary with special reference to India.

##### **Geomorphology:**

Concepts in geomorphology. Historical and process Geomorphology. Landforms in relation to climate, rock type, structure and tectonics. Processes – weathering, pedogenesis, mass movement, erosion, transportation and deposition. Geomorphic processes and landforms – structural, denudational, fluvial, glacial, aeolian, coastal and karst. River forms and processes – stream flow, stage- discharge relationship; hydrographs and flood frequency analysis. Submarine relief. Geomorphology and topographic analysis including DEM, Environmental change-causes, effects on processes and landforms. Extra-terrestrial geomorphology. Geomorphic processes and agents; development and evolution of landforms in continental and oceanic settings; tectonic geomorphology; Gross composition and physical properties of important minerals and rocks; properties and processes responsible for mineral concentrations; nature and distribution of rocks and minerals in different units of the earth and different parts of India. Physiography of the Earth; weathering, erosion, transportation and deposition of Earth's material; formation of soil, sediments and sedimentary rocks; energy balance of the Earth's surface processes; physiographic features and river basins in India

### **Structural Geology & Geo-Tectonics:**

Theory of stress and strain. Behaviour of rocks under stress. Mohr circle. Various states of stress and their representation by Mohr circles. Different types of failure and sliding criteria. Geometry and mechanics of fracturing and conditions for reactivation of pre-existing discontinuities. Common types of finite strain ellipsoids. L-, L-S-, and S-tectonic fabrics. Techniques of strain analysis. Particle paths and flow patterns. Progressive strain history. Introduction to deformation mechanisms. Role of fluids in deformation processes. Geometry and analyses of brittle-ductile and ductile shear zones. Sheath folds. Geometry and mechanics of development of folds, boudins, foliations and lineations. Interference patterns of superposed fold. Fault-related folding. Gravity induced structures. Tectonic features of extensional-, compressional-, and strike-slip-terrains and relevance to plate boundaries. mantle plumes. Himalayan Orogeny; concept of super continent, their assembly and breakup. Forces and mechanism of rock deformation; stress, strain and material response; brittle and ductile deformation; nomenclature and classification of folds and faults. primary and secondary structures; geometry and genesis of planar and linear structures (bedding, cleavage, schistosity, lineation); folds, faults, joints and unconformities; Stereographic projection; shear zones, thrusts and superposed folding; basement-cover relationship. Interpretation of geological maps. Physico-chemical and seismic properties of Earth's interior. Plate motions, driving mechanisms, plate boundaries, super-continent cycles.

### **Crystallography and Mineralogy:**

Elements of crystal symmetry, form and twinning; crystallographic projection; crystal chemistry; classification of minerals, physical and optical properties of rockforming minerals. Concept of point group, space group, reciprocal lattice, diffraction and imaging. Concepts of crystal field theory and mineralogical spectroscopy. Lattice defects (point, line and planar). Electrical, magnetic and optical properties of minerals. Bonding and crystal structures of common oxides, sulphides, and silicates. Transformation of minerals – polymorphism, polytypism and polysomatism. Solid solution and exsolution.

### **Geochemistry:**

Cosmic abundance of elements; meteorites; geochemical evolution of the earth; geochemical cycles; distribution of major, minor and trace elements in crust and mantle; elements of high temperature and low temperature geochemical thermodynamics; isotopic evolution of the crust and the mantle, mantle reservoirs; geochemistry of water and water-rock interaction. Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma -mixing, - mingling and -immiscibility.

### **Petrology:**

Petrology of common igneous, sedimentary and metamorphic rocks.

i) Igneous – Classification, forms, textures and genesis of common igneous rocks; magmatic differentiation; binary and ternary phase diagrams; major and trace elements as monitors of partial melting and magma evolutionary processes. Mantle plumes, hotspots and large igneous provinces.

ii) Sedimentology– Texture, structure and sedimentary processes; petrology of common sedimentary rocks; Sedimentary facies and environments, cyclicities in sedimentary succession; provenance and basin analysis. Important sedimentary basins of India.

iii) Metamorphic– Structures and textures of metamorphic rocks. Physico-chemical conditions of metamorphism and concept of metamorphic facies, grade and baric types; chemographic projections; metamorphism of pelitic, mafic and impure carbonate rocks; role of bulk composition including fluids in metamorphism; thermo-barometry and metamorphic P-T-t paths, and their tectonic significance.

### **Palaentology:**

Theories on origin of life. Organic evolution – Punctuated Equilibrium and Phyletic Gradualism models. Mass extinctions and their causes. Application of fossils in age determination and correlation. Paleoecology, Life habitats and various ecosystems, Palaeobiogeography. Modes of preservation of fossils and taphonomic considerations. Types of microfossils. Environmental significance of fossils and trace

fossils. Use of microfossils in interpretation of sea floor tectonism. Application of micropaleontology in hydrocarbon exploration. Oxygen and Carbon isotope studies of microfossils and their use in palaeo-oceanographic and palaeo-climatic interpretation. Important invertebrate fossils, vertebrate fossils, plant fossils and microfossils in Indian stratigraphy. Diversity of life through time, mass extinctions- causes and effects; taphonomy - processes of fossilization. Taxonomy. Morphology and functional morphology of invertebrates (bivalves, brachiopods, gastropods, echinoids, ammonites); microfossils (foraminifera, ostracoda, conodonts, bryozoa); Vertebrate paleontology (Equus, Proboscidea, Human); Paleobotany (plant, spores, pollens). Basic concepts of ecology/paleoecology; classification - ecological and taxonomic schemes (diversity and richness). Fossils and palaeo-environments.

### **Stratigraphy:**

Principles of stratigraphy and concepts of correlation; Lithostratigraphy, biostratigraphy and chrono-stratigraphy. Principles of sequence stratigraphy and applications. Recent developments in stratigraphic classification. Code of stratigraphic nomenclature – Stratotypes, Global Boundary Stratotype Sections and Points (GSSP). Methods of stratigraphic correlation including Shaw's Graphic correlation. Concept of sequence stratigraphy. Rates of sediment accumulation, unconformities. Facies concept in Stratigraphy – Walther's law. Methods for palaeo-geographic reconstruction. Earth's Climatic History. Phanerozoic stratigraphy of India with reference to the type areas– their correlation with equivalent formations in other regions. Boundary problems in Indian Phanerozoic stratigraphy. Stratigraphy of peninsular and extra-peninsular India. Boundary problems in Indian stratigraphy. Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, alkaline rocks, Kimberlites, ophiolites and granitoids

### **Resource Geology:**

Ore-mineralogy; ore forming processes vis-à-vis ore-rock association (magmatic, hydrothermal, sedimentary, supergene and metamorphogenic ores); fluid inclusions as ore genetic tools. Magmatic, hydrothermal and surface processes of ore formation. Metallogeny and its relation to crustal evolution; Active ore-forming systems, methods of mineral deposit studies including ore microscopy, fluid inclusions and isotopic systematics; ores and metamorphism- cause and effect relationships. Geological setting, characteristics, and genesis of ferrous, base and noble metals. Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps. Methods of petroleum exploration. Concepts of petrophysics, Petroliferous basins of India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resources of India. Gas hydrates and coal bed methane. Nuclear and non-conventional energy resources. Coal and petroleum geology; marine mineral resources. Prospecting and exploration of economic mineral deposits - sampling, ore reserve estimation, geo-statistics, mining methods. Ore dressing, beneficiation and mineral economics. Distribution of mineral, fossil and nuclear fuel deposits in India.

### **Engineering Geology:**

Physico-mechanical properties of rocks and soils; rock index tests; Rock failure criteria (Mohr-Coulomb, Griffith and Hoek-Brown criteria); shear strength of rock discontinuities; rock mass classifications (RMR and Q Systems); in-situ stresses; rocks as construction materials; geological factors in the construction of engineering structures including dams, tunnels and excavation sites. Seismic design of buildings Analysis of slope stability. Natural hazards (landslide, volcanic, seismogenic, coastal) and mitigation. Principles of climate change. Man-land relationship. Resources – renewable and non-renewable. Natural and man-made hazards – droughts, floods, cyclones, earthquakes, landslides, tsunamis. Ecological balance, environmental pollution and deterioration

### **Hydrogeology:**

Elements of hydro-geology, Groundwater flow (Darcy's law,) and exploration, well hydraulics and water quality. Properties of water; hydrological cycle; Groundwater, hydrological characteristics of aquifers, hydrological cycle. Precipitation, evapotranspiration and infiltration processes. Hydrological classification of water-bearing formations. Fresh and salt-water relationships in coastal and inland areas. Water resources and management. Groundwater exploration and water pollution. Groundwater regimes in India.

**Principles of Remote Sensing:**

Electromagnetic radiation – characteristics, remote sensing regions and bands; Global positioning systems energy sources and radiation principles, atmospheric absorption, interaction of energy with earth's surface; General orbital and sensor characteristics of remote sensing satellites; Spectra of common natural objects – soil, rock, water and vegetation. Aerial photos – types, scale, resolution, properties of aerial photos, stereoscopic parallax, relief displacement; Principles of photogrammetry; Digital image processing - characteristics of remote sensing data, preprocessing, enhancements, classification; Elements of photo and imagery pattern and interpretation, application in Geology; Remote sensing applications in interpreting structure and tectonics, Lithological mapping, mineral resources, natural hazards and disaster mitigation, groundwater potentials and environmental monitoring. Landsat, Skylab, Seasat and other foreign systems of satellites and their interpretation for geological and other studies; Space research in India – Chandrayaan, Mangalyaan and IRS systems and their applications, Thermal IR remote sensing and its applications, Microwave remote sensing and its applications. Principles and components of Geographic Information System (GIS), Digital Elevation Models, remote sensing data integration with GIS, applications of GIS/modelling in various geological studies.

**General Geophysics:**

Principles & applications of gravity, magnetic, electrical, electro-magnetic, seismic & well logging methods of prospecting for geological applications (oil, mineral, groundwater etc.)

**Part-B: Aptitude/Ability tests** (30 Minutes, 20 Marks, Maximum of 15 Multiple Choice Questions)

**Topics:** Numerical Reasoning; Logical Reasoning; Diagrammatic Reasoning; Abstract Reasoning; Deductive Reasoning